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IMAGE ENHANCEMENT BY SUPPRESSING WRINKLES USING L_0 NORM AND ACO

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ABSTRACT

In this article the problem of enhancing the image quality by suppressing the predetermined information (wrinkles) from it is taken into account. The technique used to do this is based on the optimisation approach followed by ants while searching for good path between their colony and source of food. In addition to this another technique that is applied to enhance detail layer is based on global optimisation filter known as L_0 norm, as other filters produces halo artefacts and gradient reversal artifacts when we enlarge the gradient of the image. In this paper three parameters are taken into account in order to validate our research for enhancing the image (1) PSNR value i.e. Peak Signal to noise ratio (2) Mean Square Error (3) Histogram Equalisation.

KEYWORDS : L_0 Norm, Ant Colony Optimisation, Guided Filter, Histogram Equalisation

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Original Article

INTRODUCTION

Detail layer algorithms are used to enhance the visual looks of the image. The fine details of the image is increased while halo artifacts and gradient reversal artifacts are avoided by following these algorithm. Image is decomposed into base layer and detail layer. Base layer is identified by homogeneous region with sharp edges and detail layer which is composed of fine detail and texture. But by using L_0 norm based filter no decomposition of the image is required, it will work directly on the given image. While enhancing the image some part of the information present in the scene get suppressed or removed. Human face of an elderly person contains some unwanted lines or wrinkles. On human face suppression of wrinkles in lieu of enhancing the image result in the production of younger looks of the person which may be used to match the face of the person stored in database records, criminals can be identified by using this technique. Prior to cosmetic surgery of the person he becomes aware of his looks by using this image editing algorithm presented in this paper.

Fei Kou et al[1] had found that the edges of the images are enhanced and amplified by using L_θ norm. Moreover. it is found that by using this filter halo artefact and gradient reversal artefacts are removed, which is difficult to overcome in filters like guided filter, bilateral filter etc. Z. Farbman et al [2] had decomposed the image into base layer and detailed layer and found that huge amount of intensity variation information is present in the base layer itself. The detail layer of the image is obtained by subtracting the base layer from the original image. The image is constructed by using Laplacian pyramid. Linear filters are used for constructing pyramids, these pyramids will result in the formation of halo artifacts. This problem can be mitigated by using non linear filters. Z.Li et al [3] had found that function of these filters is to remove noise from the image. C.T.Shen et al[4] had

found that image is decomposed using L_0 norm and L_1 norm. He had found that the preference should be given to L_1 norm instead of L_2 norm in order to avoid the state of perplextion. In this paper we will use L0 norm and Ant Colony Optimisation based approach to enhance the image containing human body parts.

PROPOSED METHODOLOGY

- Image is acquired from the user and stored in the database.
- A particular image is taken and its Fourier transformation is taken into account.
- Convolution of the given image is done to make it look brighter.
- Optical transfer function available in the MATLAB is applied on the given image.
- Image enhancement is done using L_0 norm based filter algorithm
- To further enhance the image and to suppress the corresponding wrinkles Ant Colony Optimisation technique is used.
- Inverse Fourier transformation of the given image is obtained.

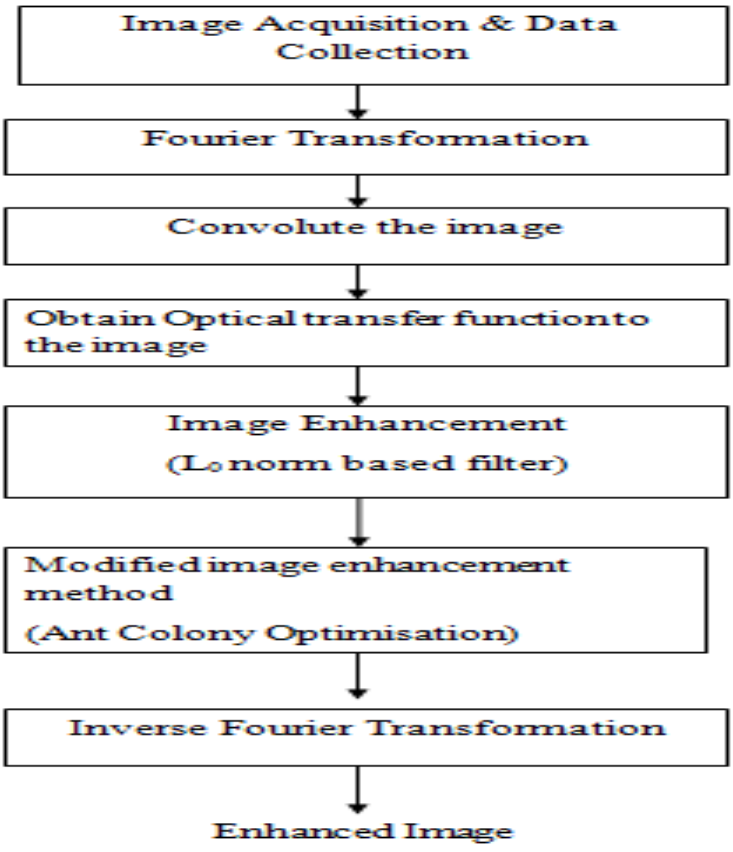

Figure 1: Proposed Methodology

RESULTS

In the table below we had shown the results of applying various filters on the human parts so as to suppress wrinkles from it**.**

Table 1: (a) Original Image (b) Guided Filter Image (c) L_0 norm Based Filter (d) L_0 norm and ACO Based Filter

	(a)	(b)	(c)	(d)
Sr. No.	Original Image	Guided Filtered Image	L_0 norm Filter Based Image	(d)L_0 norm and ACO Based Filter Image
1				
2				
3				
4				
5				

The table and graph below shows that our proposed technique is showing better results as compared to other filters. The lesser is the mean square error than better is the results and in our case the mean square error value is reduced in significant amount.

Table 2: Mean Square Error Values of Various Filters

Guided Filter	L_0 Norm Based Filter	Proposed Method
80.1	81.1	52.2
81.1	82.3	51.4
80.2	83.2	53.1
79.9	81.1	55.1
80.6	83.3	54.1

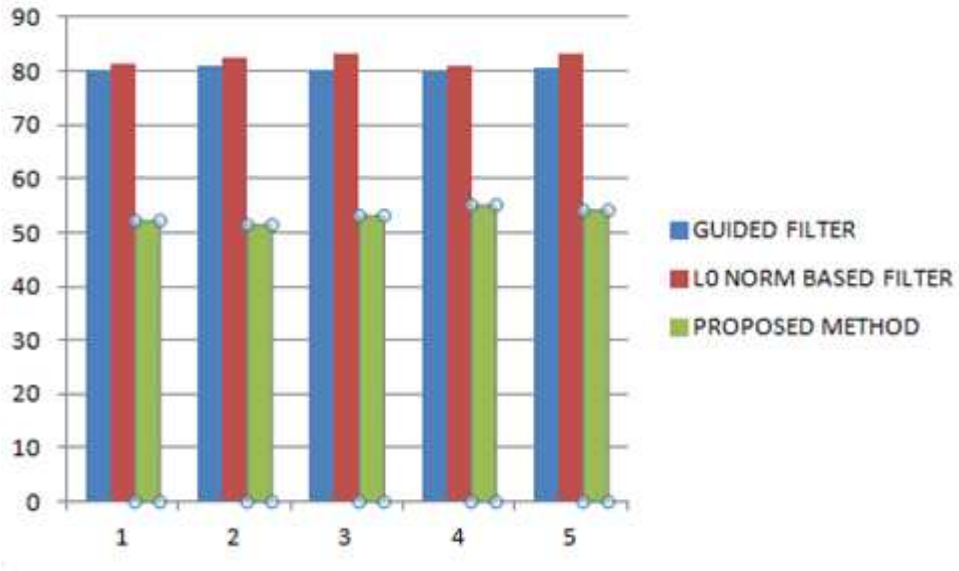

Figure 2: Mean Square Error Values

The table and graph above shows the improvement of our proposed filter over various filters. The table shows that the amount of information obtained by using peak signal to noise ratio is much larger in our proposed technique as compared to any other filters.

Table 3: Peak Signal to Noise Ratio of Various Filters

Guided Filter	L_0 norm Based Filter	Proposed Method
80.2	82.2	99
79.5	81.2	91.5
81.2	80.1	100.2
80.1	81.1	101.9
80	80	102.2

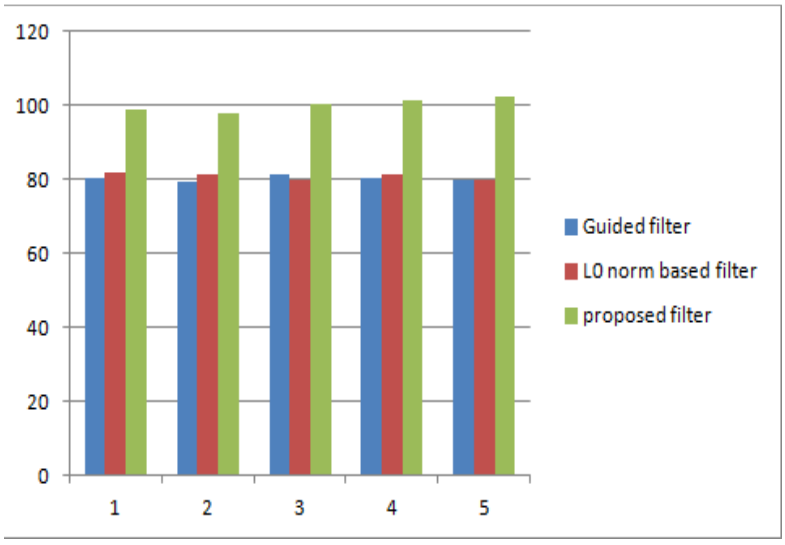

Figure 3: Peak Signal to Noise Ratio

Next we compare histogram Equalisation of various fiters.

Figure 4: (a,e) Original Image & Histogram Equalization (b,f) L_0 norm and ACO Based Filtered Image & Histogram Equalization (c,g) Guided Filter Image & Histogram Equalisation (d,h) L_0 norm Based Filtered Image & Histogram Equalisation

The Histogram Equalisation of various filters is shown in the figure above. As it can be observed that more is the spread in the histogram from its mean position brighter is the image supposed to be produced. In our case the proposed algorithm image and guided filter image both are showing equal enhancement of the image.

Next we compare the time complexity of all the filters used in this paper.

Table 4: Time Complexity of Various Filters

Algorithm	Time Complexity
L_0 norm filter	$\theta(n!)$
Guided Filter	$\theta(1)$
L_0 norm and ACO filter	$\theta(n)$

CONCLUSIONS

From the above experiment we found that the time complexity of our algorithm is high as compared to other filters available. As there is trade off between the time to produce result and amount of image enhanced. Our proposed algorithm produces better quality as compared to other available filters.

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